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ABSTRACT

The purpose of this study was to determine the prior knowledge of students regarding scientists and their work. Students' depictions of scientists in pictures were compared to their responses in agreement or disagreement to statements about scientists and their work. The 124 seventh grade students drew a picture of a scientist and told why they agreed or disagreed with certain statements. Pictures were analyzed using the stereotypic features attributed to scientists as reported in earlier studies such as gender, lab coat, eyeglasses, hair, and symbols of research. Categories of students' responses to the statements emerged from the data. Written responses indicated that students had a more realistic view of scientists and their work than the stereotypic images drawn by the students indicated. Results indicate that caution should be used when interpreting the pictures students draw of scientists. Contains 16 references. (Author/JRH)

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LEARNING FROM PRACTICE: IMPRESSIONS FROM PICTURES OF SCIENTISTS DON'T TELL THE WHOLE STORY

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A paper presented at the annual meeting of the National Association for Research in Science Teaching, Oak Brook, IL, March, 1997.

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Learning from Practice: Impressions from Pictures of Scientists Don't Tell the Whole Story.

Joy E. Bielenberg, Albertson College of Idaho

The purpose of this study was to determine the prior knowledge of students regarding scientists and their work. Students' depictions of scientists in pictures were compared to their responses in agreement or disagreement to statements about scientists and their work. The 124 seventh grade students drew a picture of a scientist and then told why they agreed or disagreed with statements such as, "Science is a job for men." Pictures were analyzed using the stereotypic features attributed to scientists as reported in earlier studies: gender, lab coat, eyeglasses, hair, and symbols of research. Categories of students' responses to the statements emerged from the data. For example, the categories for students' disagreement with the statement, "Science is a job for men," ranked in order of times utilized by students were: women are capable, women are smart, science is a job for everyone, men and women have equal rights, and women are scientists. Results indicated that caution should be used when interpreting the pictures students draw of scientists. Written responses indicated that students had a more realistic view of scientists and their work than the stereotypic images drawn by the students indicated.

Many surveys have utilized children's drawings of scientists to depict the images that children hold of scientists and their work (Chambers, 1983; Finson, Beaver, & Cramond, 1995; Fort & Varney, 1989; Huber & Burton, 1995; Schibeci & Sorensen, 1983). Recently, in the September, 1996, issue of Science and Children, teachers were invited to include their students in a research project by administering a slightly modified version of the Draw-a-Scientist Test (DAST) coupled with a short interview to answer the question: "How Do Students *Really* View Science and Scientists?" [italics in original]

Images: Past and Present

What do the students' pictures of scientists really reveal about their perceptions of science? The question has ongoing appeal for several reasons. Some researchers are interested in how reported perceptions have changed over time. According to Chambers (1983), the varied views of scientists in the eighteenth and nineteenth centuries have been cleaned up and standardized:

> During the eighteenth and nineteenth centuries visual and verbal images of the scientist were many and varied. Caricaturists, cartoonists, artists, and writers produced a diverse range of stereotypic figures: diabolical madmen, distinguished professors, harmless eccentrics, learned buffoons, and fashionable dilettantes. Naturalists in the field among flora and fauna were often pictured, as were physical scientists in their laboratories surrounded by vials and beakers....With a few exceptions, these images are now seldom seen. (p. 255)

What Chambers called the new standard image was described by Mead and Metraux (1957). They compiled the image from essay samples of

35,000 high school students and visual materials which included children's drawings made in response to the instruction, "Draw a Scientist" (Mead & Metraux, p. 386). Here is the shared image of the scientist which emerged:

> The scientist is a man who wears a white coat and works in a laboratory. He is elderly or middle aged and wears glasses. ...He may be bald. He may wear a beard, may be unshaven and unkempt....He is surrounded by equipment: test tubes, bunsen burners, flasks and bottles....He spends his days doing experiments. (pp. 386-387)

Positive and Negative Images

Mead and Metraux emphasized that in addition to the shared image there are also positive and negative sides to the image. Scientists are viewed as intelligent, serious, careful, patient, devoted and painstaking. However, they are negatively depicted as brains who work alone at repetitive, perhaps dangerous, work. They may be boring, ungodly men who neglect their families.

The differences between the positive and negative images would not have been discovered had Mead and Metraux (1957) used only one sentence stem as an essay starter. They found that if only the first stem: "When I think about a scientist, I think of" (p. 385) had been used, "it would have been possible to say that the attitude of American high-school students to science is all that might be desired" (p. 387). According to their composite image in response to this stem:

> The scientist is seen as being essential to our national life and to the world; he is a great, brilliant, dedicated human being, with powers far beyond those of ordinary men, whose patient researches without regard to money or fame lead to medical cures, provide for technical progress, and protect us from attack. We need him and we should be grateful for him. (p. 387)

The personal involvement required of students asked to respond to the stem "If I were going to be a scientist, I should like to be the kind of scientist who" (p. 385) brought about different responses. Students seemed to recognize that superhuman work requires effort..."the positive image of very hard, only occasionally rewarding, very responsible work is also one which, while it is respected has very little attraction for young Americans today" (p. 387).

Draw-a-Scientist Test

More recently, the DAST has been used to determine when the stereotypic image emerges among school children. The DAST uses lab coat, eyeglasses, growth of facial hair, symbols of research, symbols of knowledge, technology, and relevant captions as stereotypic indicators. Early studies reported that the average number of stereotypic indicators per student included in drawings increased as children progress through successively higher grade levels (Chambers, 1983; Schibeci & Sorensen, 1983).

Researchers who assume that changes in perceptions will be accompanied by changes in the images children draw, have used the DAST to test the feasibility of interventions to change perceptions (Finson, Beaver, and Cramond, 1995; Huber & Burton, 1995). The instrument is attractive because it can be administered to young children and is easily scored.

Purpose

I became convinced by the wide array of studies involving student conceptions that to improve my teaching I needed to develop

more awareness of the notions of individual students. My goal was to improve unit planning by taking students' existing conceptions into consideration. This study was part of a larger effort to determine appropriate tools for assessing the prior knowledge of students. I began a collection of students' responses using various data collection techniques. The year previous to this study, I used the Draw-a-Scientist Test with my seventh grade life science students. The results didn't make sense to me. For example, many of the girls who had expressed interest in science as a profession drew male scientists. Their pictures convinced me that involving students in the work of scientists had not been enough to influence the majority to depict scientists in ways that differ from common stereotypes.

In this study, in an effort to get a clearer picture of students' perceptions of science, I used the DAST in combination with ten statements regarding the nature of science (see Appendix A). I compared what students depict when asked to draw a picture of a scientist to students' reasons for agreeing or disagreeing with statements about the nature of science and scientists.

Method

Subjects

The subjects were 124 life science students in grade seven. All of the participants were members of my classes. Data from 11 students who completed only the responses to the 10 statements, and 4 students who completed only the drawing were not included.

Treatments

In October of 1994 I asked my life science students to draw a picture of a scientist. They were provided with a blank sheet of paper and given 20 minutes to draw the picture. After the students completed the drawings, I asked them to respond to a series of 10 statements found in Science Plus (see Appendix A). Examples of statements include: "1. Science is what we know about everything around us. 2. Science is a job for men. 10. Scientists are different from most other people." Students were instructed to indicate whether they agreed, disagreed, or were uncertain about each statement and to give a brief reason for each response. The statements were read orally, each repeated three times.

Analyses

Pictures were analyzed using the stereotypic features attributed to scientists as reported in earlier requests to draw a scientist. Features included gender of the student, gender of the scientist, lab coat, eyeglasses, hair on end, facial hair or baldness, and symbols of research.

Responses to three of the ten statements were studied in detail. These were selected based on the ability of the pictures drawn by the students to provide information about each statement. The statements analyzed were: "Science is a job for men," "Scientists are different from most other people," and "Science is what you do in the laboratory." First, the number of students who agreed, disagreed, or were uncertain about each statement were determined. Then each statement was individually analyzed. All of

the reasons were listed and sorted. Category titles were selected based on the language used by the students.

A quick perusal indicated an apparent lack of congruence between the information portrayed by the pictures and the students' reasons for agreeing or disagreeing with the statements. The day after the data collection I asked the students to help me understand the differences.

Results

Draw a Scientist

In my students' drawings of scientists, 73% were male, 19% were female, and for 8% the gender was either uncertain or the scientist was missing from the picture. Twenty-one of the 63 girls in my classes, or 33%, drew female scientists. Three boys drew female scientists. Fifty-eight percent of the scientists are wearing lab coats, 69% are pictured with test tubes or flasks, and 42% are wearing glasses or goggles. Of the males, 23 have facial hair, 15 are bald or have tufts of hair on the sides of their heads, and 31 have hair standing on end.

Science is a Job for Men

Students overwhelmingly disagreed with the statement, "Science is a job for men." Only two students, both boys, agreed with the statement and gave as their reason that men are smarter than women. The reasons students gave for disagreement with the statement were sorted into five major categories (see Table 1).

Women are capable. Thirty-eight students talked about women being just as capable or doing as well as men: "Women can do

TABLE 1
Summary of reasons by category used to agree or disagree with statement:
"Science is a job for men."

	Categories of Response						
Response to Statement	Women are Capable	Equal Intelligence	Job for All	Equal Rights	Women Scientists Exist	Personal Preference	No Reason
Disagree (122)	26 girls 12 boys	12 girls 11 boys	10 girls 15 boys	11 girls 6 boys	7 girls 9 boys	2 girls 4 boys	4 boys
Agree (2)		2 boys					

Note The total is greater than 124 because several students used more than one category.

TABLE 2
Summary of reasons by category used to agree or disagree with statement:
"Scientists are different from most other people."

	Categories of Response						
Response to Statement	Scientists are Normal	Job is What is Different	Smarter	Attitude/ Opinions/ Interests	Everybody's Different	Waky	Not Sure/ No Reason
Disagree (95)	65	11	19				
Agree (23)			10	9		1	3
Uncertain (6)			1		1		4

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everything men can" (student 4, a girl who drew a balding male chemist), "No, there are many women scientists, too, and they can do just as good" (student 6, a boy who drew a very sinister male scientist). Girls were more than twice as likely as boys to use capability as a reason for disagreeing with the statement (see Appendix B for responses coupled with drawings).

Equal intelligence. Intelligence and the genderless nature of the job were each mentioned by 25 students. Eleven boys and twelve girls agreed that girls can be as smart or sometimes smarter than boys: "No, because women are just as smart" (student 120, boy who drew a balding man in a lab coat), "Disagree, because some women are smarter than men" (student 9, boy who drew a male in a lab coat with hair on end and a flask in his hand). There were also the two boys who agreed with the statement on the basis of intelligence. "Agree, because men are cool and smarter than women" (student 39, boy who drew a male with a light bulb and E=mc2 over his head).

Job for all. Fifteen boys and 10 girls disagreed with the statement on the grounds that science could be a job for a man or a woman: "Disagree, it's also a job for women" (student 12, a boy who drew a male in a lab coat), "Disagree, all people should be able to be a scientist" (student 21, a boy who drew a male with a beard and hair tufts), "Disagree, men and women can be scientists" (student 65, a girl who drew a female scientist).

Equal rights. An additional 11 girls and 6 boys mentioned equality or equal rights: "Disagree, women have rights, too" (student 8, a girl who drew a scar-faced male), "Disagree, men and

women have their rights" (student 25, a boy who drew a hairy-chested inventor), "Disagree, men and women are equal" (student 69, a girl who drew a female scientist in a lab coat).

Women scientists exist. Sixteen students used the existence of female scientists and doctors as reasons to refute the, "Science is a job for men," statement: "False, there are lady scientists" (student 105, a boy who drew a triangular face with hair on end), "Disagree, because women are scientists, too" (student 116, a girl who drew a female scientist with a lab coat over her skirt), "Disagree, because there are millions of women associated with science" (student 115, a girl who drew a male in a lab coat).

Scientists are Different

Although students picture scientists as different, most do not agree with the statement, "Scientists are different from most other people." Ninety-five students disagreed, 23 agreed, and 6 were uncertain (see Table 2).

Scientists are normal. Of the 95 students who disagreed with the statement, 65 students indicated that scientists are normal, the same as everyone else, or just people like us: "Disagree, they are just normal people" (student 75, a boy who drew a male with an enlarged mouth and extended tongue), "Disagree, they're just like everyone else" (student 50, a girl who drew a male with hair on end), "Disagree, they're people just like everybody" (student 42, a girl who drew a female with glasses, a pocket protector, and an award for being smart), "I disagree because normal people become scientists" (student 49, a boy who drew an enlarged head with veins

popping out, thinking equations)(see Appendix C for responses coupled with drawings).

Different job. Eleven students who disagreed with the statement explained that scientists are just people with a different job: "False, they're the same, being a scientist is just their job" (student 104, a girl who drew a female in a laboratory), "I disagree, they are different in the sense of job, but they are still human beings" (student 45, a girl who drew a male with glasses, mustache, and hair on end), "I disagree because everybody has a different job, and that's their job" (student 57, a girl who drew a female with a bow in her hair).

Smarter. Thirty students thought scientists were or may be smarter than the average person. Nineteen who disagreed with the statement, indicated that although scientists are like other people they are also smarter: "Disagree, scientists are smart, but that doesn't make them different" (student 70, a girl who drew an Einstein depiction), "Disagree, they look the same but may be a little smarter" (student 20, a boy who drew a muscled, grimacing male with long hair on end), "I disagree, yes they are smarter, yet still not oddballs" (student 95, a girl who drew a male with an enlarged head, beard, mustache and hair tufts). Ten students indicated that scientists are different because they are smarter than other people: "Agree, most scientists are a lot smarter than the average person" (student 17, a girl who drew an unshaven, cigarette smoking man with wounds and stringy, long hair).

Attitudes, opinions, interests. Nine students indicated that

it was scientists' attitudes, opinions, ways of knowing, availability of tools, or interests that set them apart: "Agree, because they want to know so much" (student 44, a boy who drew a male scientist with hair on end), "Agree, because everybody has their own opinion" (student 55, a girl who drew a male face with a mustache), "Agree, scientists are different because they figure things a lot different than others" (student 67, a girl who drew a person of uncertain gender in a top secret laboratory), "Yes, they use high power microscopes that regular people can't use" (student 108, a boy who drew a goggled male with hair on end). Three students gave no reason for their responses.

Wacky. Only 1 student indicated that scientists are different because they are wacky: "Agree, some are kind of waky [sic]" (student 96, a boy who drew a rather normal looking male in a lab coat).

Science Takes Place in a Laboratory

Although 97 students drew scientists in a laboratory or with lab equipment, only 20 students agreed with the statement: "Science is what you do in the laboratory." Seventy-six of the students who disagreed with the statement drew a picture of a scientist either in a laboratory or with equipment such as flasks and test tubes (see Table 3).

Lab is safe, location of materials. Students who agreed with the statement did so primarily for pragmatic reasons. The categories of response included safety and the location of materials and experiments: "Yes, you don't want harmful chemicals

TABLE 3
Summary of reasons by category used to agree or disagree with statement
"Science is what you do in the laboratory."

	Categories of Response								
Response	Safety	Location of Experiments	Location of Material	No Reason	Work with Chemicals	Anywhere/ Everywhere	Outside, Home	Classroom	Elsewhere
Disagree (97)				1		54	30	6	6
Agree (20)	5	5	4	5	1				
Uncertain (7)				3		3	1		

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escaping" (student 122, a boy who drew a bald male scientist in a lab), "Yes, because it has the materials you want to work with" (student 110, a girl who drew a female in a lab), "Agree, experiments and things about science are carried out there" (student 71, a girl who drew a female in a lab) (see Appendix D).

Anywhere, everywhere, outside. Of the 97 students who disagreed with the statement, 54 indicated that science could be conducted anywhere or everywhere; another 30 stated that science could be done at home, outside or other places; and six mentioned that they carried out science at school: "Disagree, you can do it anywhere" (student 3, a boy who drew a large-headed scientist in tattered clothes in a lab), "I disagree because you can do science in a classroom or at home" (student 53, a girl who drew a female in a lab), "Disagree, you do some science in lab, but you can do it elsewhere outside, in the forest, anywhere" (student 64, a girl who drew a female scientist in a lab), "Disagree, because you can also look at nature outside" (student 83, a girl who drew a male scientist in a lab), "Disagree, you can do it in a classroom all the time" (student 38, a girl who drew a female scientist without surroundings).

Class Discussion

The number of females drawn by my students represented an increase over other studies. My overall impression of my students' perceptions still left me pessimistic about their understanding of scientists and their work. On the other hand their responses to the statements were cause for optimism. In an effort to understand

the discrepancy between my impressions from the drawings and the explanations students gave in response to the 10 statements, I returned to the students. I explained that I was confused. I said, "Please, think about the picture you drew and think about your answers to the 10 statements I read. Can anyone tell me why I might be feeling like I'm getting different information from these two sources?" Students volunteered answers: "I drew a man, but I know that a scientist can be a man or a woman." "Mrs. Bielenberg, Don't you know that we are going to think about the weird scientists on TV and draw them?" "It's more fun to draw a wacko."

Discussion

What did the conspicuous differences between the impressions engendered by the pictures of scientists and the responses to the statements mean? Should I be questioning the practices I was using? Were the pictures indicating that my practices were inadequate to change the stereotype? Were the images from previous studies being misinterpreted?

Job for Men

A smaller percentage of students in this study drew males (73%) than in other studies. Chambers (1983) reported that the Draw-a-Scientist Test was administered to 4807 children. He was interested in the number of stereotypic indicators used by children of different ages, so he did not report the percentage of children drawing women. Using his figures of 28 female scientists drawn, I computed the percentage at .5%. Fort and Varney (1989) reported

that eighty-six percent of the girls drew male scientists and ninety-nine percent of the boys wrote about male scientists. "Out of the 1,654 respondents, only 135 (about 8 percent) pictured female scientists." By comparison, two-thirds of the girls in my class drew male scientists. Using only the pictures of scientists as a measure, faint progress is being made on replacing the perception that science is a male domain.

More importantly, there is a striking difference between the impression left by the pictures of scientists and what students have to say regarding scientists and their work. My students reported that women are as capable and as intelligent as men and that science is a job for women, too. Teachers, teacher educators, and researchers have been concerned about the availability of science as an option for girls and minorities. They have hypothesized that students' characterization of the field(s) needs to be changed through the introduction of appropriate role models, a clearer conceptualization of how scientists spend their time, etc. Older studies have implicated the stereotypic view of science as a male domain as a major reason for young women not considering science as a profession (Kelly, 1987, first published in 1981; Oakes, 1990). The American Association of University Women (AAUW, 1991) reported that as girls grow up they lose confidence in their academic abilities and lower their career aspirations. The young men and young women in my class considered the profession equally open to men and women. The question that goes unanswered is: Are decisions being made based on a stereotype pervasive in our culture

or based on personal beliefs? That is are young women saying, "I don't want to be associated with a profession that is considered masculine by the general public, the media, and others even though I myself know differently"? Baker and Leary (199~) reported a similar disparity between girls' responses to equity statements and the reasons they give for not selecting science as a career choice.

Scientists are Different

Larry Flick (1989) summarized the stereotype of scientists compiled from student perceptions:

> Scientists are middle-aged white males who wear lab coats and glasses. Their peculiar facial features are indicative of their generally deranged behavior. They work indoors, alone, perhaps underground, surrounded by smoking test tubes and other pieces of technology. (p. 6)

A look at the pictures drawn by my students may leave the viewer with a similar impression. What is striking is the lack of congruence between what students say about scientists versus how they are pictured. Students who said that scientists are normal people drew pictures of highly abnormal individuals. Conversely, the one student who indicated that scientists can be "waky" [sic], drew a normal person.

According to students' statements, if scientists are different, it is because they are more intelligent than the average person or have different interests. Some students use a difference in intelligence to confirm difference; others acknowledge intelligence as an attribute of scientists which does not set them apart.

If scientists aren't different from most other people, why are

they pictured so differently? Apparently, some students draw pictures of the images they have seen of scientists because they are well aware of the stereotype and it is fun to depict.

Science Takes Place in a Laboratory

Students clearly believe that science can be conducted outside of the laboratory. Yet 76 of the students who disagreed with the statement that science takes place in the laboratory, pictured a scientist in a laboratory or surrounded by laboratory equipment. How can there be such a difference in the two sources of information? Perhaps Mead and Metraux (1957) provided a clue. They discovered that the image of the scientist that resulted from an impersonal request about science was quite different from one that required personal involvement. My request to draw a scientist may similarly be perceived as a request for the standard image, whereas requiring individuals to agree or disagree with statements engaged personal belief systems.

Conclusions

How do students really view science and scientists? Barman's (1996) recent request for more information about students' views differs in two ways from earlier tests. Following the suggestion of Huber and Burton (1995), Barman (1996) has changed the instructions from "Draw a picture of a scientist," to "Draw a picture of a scientist at work." According to Huber and Burton the change resulted in a clearer image of what it means to be a scientist because the pictures drawn in response contained greater detail. The second change is the addition of an interview which

asked each student to explain the drawing of the scientist and then to explain a drawing of himself or herself doing science in school. Although the information will provide greater understanding of the influences behind the pictures, I'm uncertain that it will tell us what children really think about science. Will it explain the kind of disparity depicted in my student's pictures of scientists versus their statements about scientists?

Why is the difference important? Originally I presumed the importance resided in our misinterpretation of the pictures. The pictures indicated that little progress had been made in changing students' views about scientists. They were still frequently pictured as balding chemists working alone or frantic madmen. The good news was that, according to students' responses to the statements, the students knew that their pictures weren't reality.

Now I believe it is important to question the tenacity and significance of the stereotype. When faced with making decisions regarding science, does the stereotype have greater veracity than an individual's beliefs? Are students making decisions based on what they perceive society believes about science or on their own reasoned answers based on capability, equity, and intelligence?

Classroom Implications

Using students' pictures of scientists as one indicator of their perceptions can be very useful. In an earlier study I found that asking students to draw a picture of a scientist before viewing the lives and work of non-stereotypic scientists provided students with an opportunity to confront their own images.

(unpublished paper). The widespread presence of the indicators of the standard image of the scientist in the pictures drawn by my students served as evidence that providing students with opportunities to use the processes of science was not sufficient to confront the stereotypic images of science. Pictures alone left me with a negative impression of students' attitudes toward scientists. Written responses to the ten statements indicated that students had a more realistic view of scientists and their work than the stereotypic images drawn by the students indicated. A better understanding of why the pictures and statements are in disagreement is needed. Finson, Beaver, and Cramond (1995) indicated that the results of interviews where students were asked to describe scientists confirmed the results of the drawings. Are my results different primarily because students are asked to personalize the information by agreeing or disagreeing? I question whether the pictures students have drawn should be given as much credibility as they have been given as a measure of our progress toward a reasonable view of scientists. Teachers and researchers should be cautious about the meanings they ascribe to children's pictures of scientists.

Bibliography

American Association of University Women. (1991). Summary: Shortchanging girls, shortchanging America. Washington, DC: Author.

Baker, D. & Leary, R. (1995). Letting girls speak out about science. Journal of Research in Science Teaching, 32, 3-27.

Barman, C. R. (1996). How do students *really* view science and scientists? Science and Children, 34(1), 30-33.

Bielenberg, J. (1996). Learning from practice: Images of Scientists. Unpublished manuscript.

Chambers, D. (1983). Stereotypic images of the scientist: The Draw-A-Scientist Test. Science Education, 67(2), 255-265.

Finson, K.D., Beaver, J.B. & Cramond, B.L. (1995). Development and field test of a checklist for the Draw-A-Scientist Test. School Science and Mathematics, 95(4), 195-205.

Flick, L. (1989). Will the real scientist please stand up! Science Scope, 13(3), 6-7.

Fort, D., & Varney, H. (1989). How students see scientists: Mostly male, mostly white, and mostly benevolent. Science and Children, 26(8), 8-13.

Guzzetti, B.J., & Williams, W.O. (1996). Gender, text, and discussion: Examining intellectual safety in the science classroom. Journal of Research in Science Teaching, 33, 5-20.

Huber, R.A., & Burton, G.M. (1995). What do students think scientists look like? School Science and Mathematics, 95(7), 371-376.

Kelly, A. (1987). Why girls don't do science. In A. Kelly (Ed.), Science for girls? (pp.12-17). Philadelphia: Open University Press.

McFadden, C. & Yager, R.E. (Project Directors). (1993). Science Plus: Technology and Society (annotated teacher's edition). Austin: Holt, Rinehart, and Winston, Inc.

Mead, M., & Metraux, R. (1957). Image of the scientist among high-school students: A pilot study. Science, 126, 384-390.

Oakes, J. (1990). Opportunities, achievement, and choice: Women and minority students in science and mathematics. In C.B. Cazden (Ed.), Review of Research in Education (pp. 153-222). Washington, D.C.: American Educational Research Association.

Schibeci, R.A., & Sorensen, I. (1983). Elementary school children's perceptions of scientists. School Science and Mathematics, 83(1), 14-20.

Weinburgh, M. (1995). Gender differences in student attitudes toward science: A meta-analysis of the literature from 1970 to 1991. Journal of Research in Science Teaching, 32, 387-398.

Appendix A

Statements regarding the nature of science from activity, page four in SciencePlus.

1. Science is what we know about everything around us.
2. Science is a job for men.
3. Science is a method for finding things out.
4. Scientific ideas never change.
5. Science is what you do in the laboratory.
6. Science is information about the world that will be useful later in life.
7. Science is exploring space.
8. Science is doing experiments.
9. Science is a collection of facts.
10. Scientists are different from most other people.

Appendix B

Responses to Statement: "Science is a job for men" coupled with students' drawings of scientists.

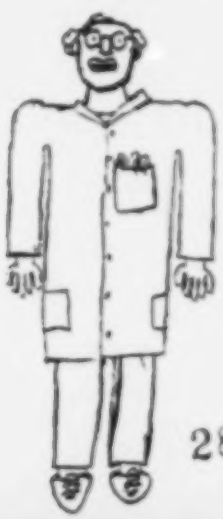
Category: **Women are capable**

Student 4: (girl) "Women can do everything men can."

Student 6: (boy) "No, there are many women scientists, too, and they can do just as good."

Category: **Intelligence**

Student 120: (boy) "No, because women are just as smart."



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Student 9: (boy) "Disagree, because some women are smarter than men."

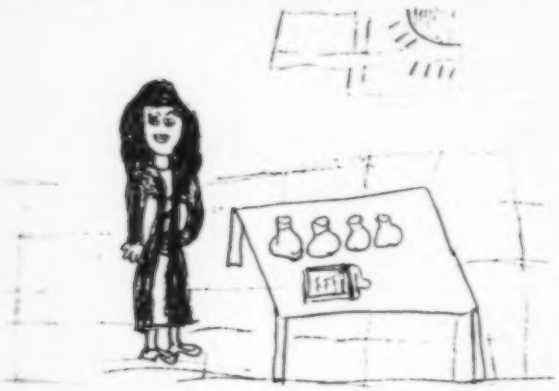
Student 39: (boy) "Agree, because men are cool and smarter than women."

Category: **Job for All**

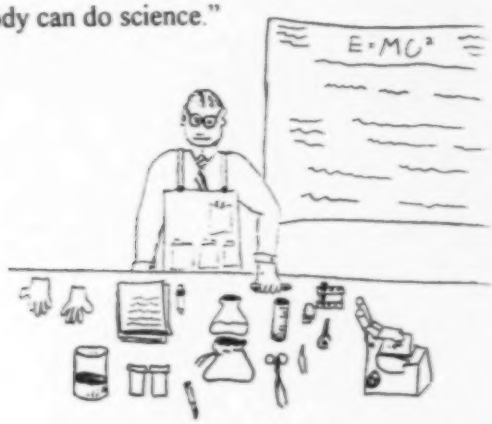
Student 12: (boy) "Disagree, it's also a job for women."

Student 21: (boy) "Disagree, all people should be able to be a scientist."

Student 65: (girl) "Disagree, men and women can be scientists."



Student 33: (boy) "Disagree, anybody can do science."



Student 66: (girl) "Disagree, because women can have science as job also."

Student 81: (boy) "Disagree, science is a job for anyone."

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Category: **Equal Rights**

Student 8: (girl) "Disagree, women have rights, too."

Student 25: (boy) "Disagree, men and women have their rights."

Student 69: (girl) "Disagree, men and women are equal."

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Category: **Women are scientists**

Student 105: (boy) "False, there are lady scientists."

Student 116: (girl) "Disagree, because women are scientists, too."

Student 115: (girl) "Disagree, because there are millions of women associated with science."

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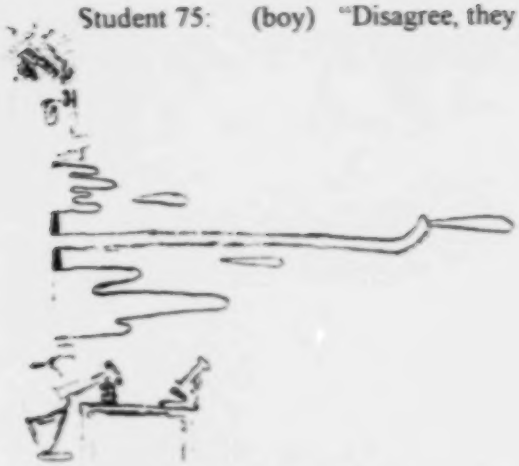
Appendix C

Responses to Statement: "Scientists are different from most other people."

Category: **Normal people**

Student 75: (boy) "Disagree, they are just normal people."



Student 50: (girl) "Disagree, they are just like everyone else."

Student 42: (girl) "Disagree, they're people just like everybody."

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Student 49: (boy) "I disagree because normal people become scientists."

Category: **Different job**

Student 104: (girl) "False, they are the same, being a scientist is just their job."

Student 45: (girl) "I disagree, they're different in the sense of job, but they are still human beings."

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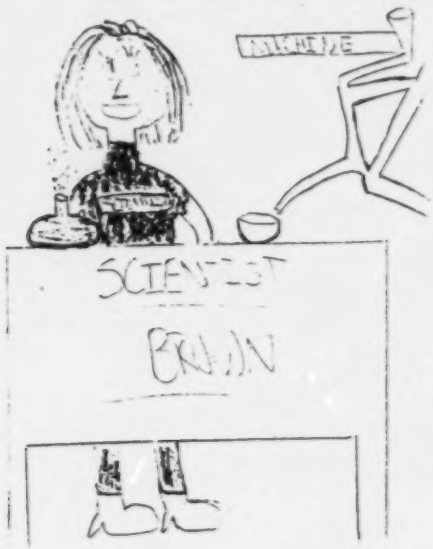
Student 57: (girl) "I disagree, because everybody has a different job, and that's their job.



Category: **Alike, but smarter**

Student 70: (girl) "Disagree, scientists are smart, but that doesn't make them different."

Student 20: (boy) "Disagree, they look the same but may be a little smarter."

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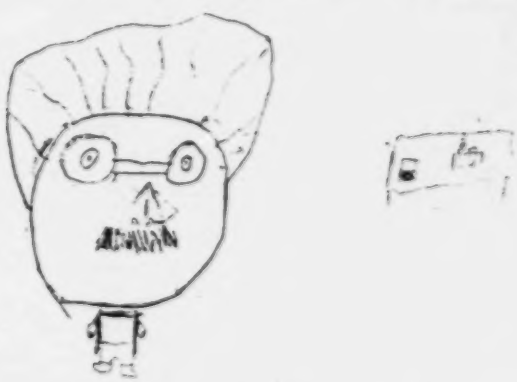
Student 95: (girl) "I disagree, yes they are smarter, yet still not oddballs."

Category: **Different, smarter**

Student 17: (girl) "Agree, most scientists are a lot smarter than the average person."

Category: **Attitudes, Interests different**

Student 44: (boy) "Agree, because they want to know so much."



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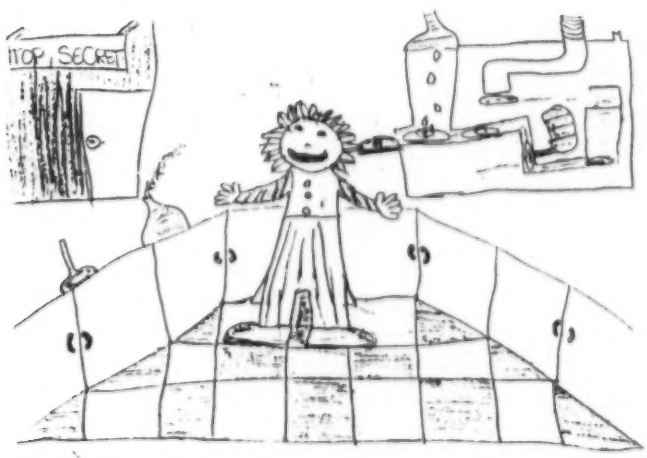
Student 55: (girl) "Agree, because everybody has their own opinion."

Student 67: (girl) "Agree, scientists are different because they figure things a lot different than others."



Student 108: (boy) "Yes, they use high power microscopes that regular people can't use."

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Category: **Wacky**

Student 96: (boy) "Agree, some are kind of waky."

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Appendix D

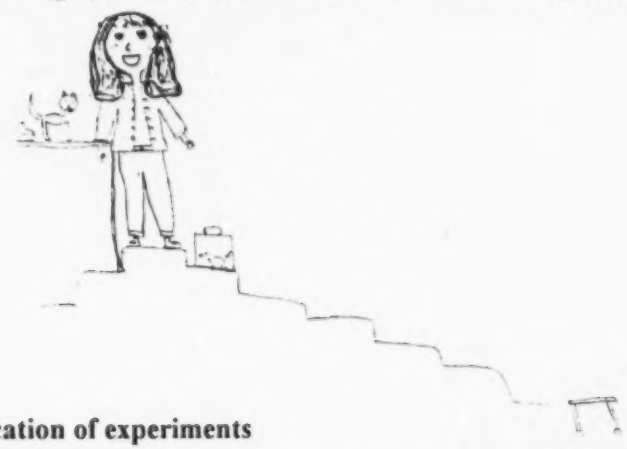
Responses to Statement: "Science is what you do in the laboratory."

Category: **Safety**

Student 122: (boy) "Yes, you don't want harmful chemicals escaping."

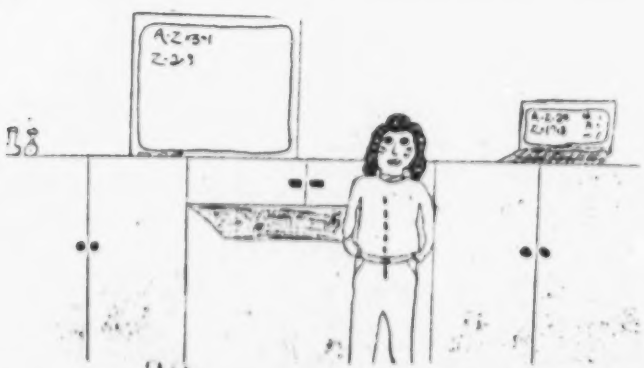
Category: **Location of materials**

Student 110: (girl) "Yes, because it has the materials for you to work with."



Category: **Location of experiments**

Student 71: (girl) "Agree, experiments and things about science are carried out there."



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Category: **Anywhere, everywhere**

Student 3: (boy) "Disagree, you can do it anywhere."

Category: **Outside, home, classroom**

Student 53: (girl) "I disagree, because you can do science in a classroom or at home."

Student 64: (girl) "Disagree, you do some science in lab, but you can do it elsewhere outside, in the forest, anywhere."

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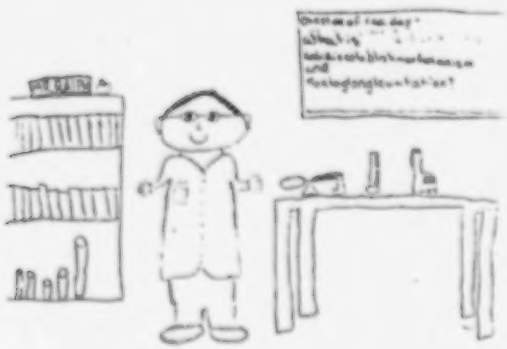
Student 83: (girl) "Disagree, because you can also look at nature outside."



Student 38: (girl) "Disagree, you can do it in a classroom all the time."

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